

Enterohemorrhagic *E. coli*, including *E. coli* O157:H7 (Shiga toxin-producing *Escherichia coli*)

1. DISEASE REPORTING

A. Purpose of Reporting and Surveillance

1. To determine if there is a source of infection of public health concern (e.g., contaminated ground beef) and to stop transmission from such a source.
2. When the source of infection appears to pose a risk to only a few individuals (e.g., a private water supply), to inform those individuals how they can reduce their risk of exposure.
3. To assess the risk of the case transmitting infection to others, and to prevent such transmission.
4. To identify outbreaks and other undiagnosed cases.

B. Legal Reporting Requirements

1. Health care providers: **immediately notifiable to local health jurisdiction.**
2. Hospitals: **immediately notifiable to local health jurisdiction.**
3. Laboratories: identification of Shiga toxin-producing organism notifiable to local health jurisdiction within 2 workdays; submission of stool specimen or isolate to the Washington State Department of Health (DOH) Public Health Laboratories (PHL) required.
4. Local health jurisdictions: notifiable to DOH Communicable Disease Epidemiology Section (CDES) within 7 days of case investigation completion or summary information required within 21 days.

C. Local Health Jurisdiction Investigation Responsibilities

1. Begin investigation within one working day.
2. Report all confirmed, probable and suspect cases to CDES (see case definitions in Section 3). Use the Enterohemorrhagic *E. coli* DOH case report form, which can be found on the DOH website at: www.doh.wa.gov/notify/forms/ecoli.doc.
 - a) Report enterohemorrhagic *E. coli* with Hemolytic-Uremic Syndrome (HUS) as enterohemorrhagic *E. coli*.
 - b) Report post-diarrheal HUS as suspect enterohemorrhagic *E. coli*.
 - c) Report HUS without a clear history of acute or bloody diarrhea as HUS. (*See investigative guidelines for hemolytic-uremic syndrome*).
3. If a laboratory identifies Shiga toxin in a stool specimen but does not perform stool culture, please facilitate case confirmation and isolate typing by requesting that a stool specimen be sent to PHL for culture. In addition, ensure that labs forward the first isolate from each patient to the Public Health Laboratories (PHL) for confirmation.

2. THE DISEASE AND ITS EPIDEMIOLOGY

A. Etiologic Agents

Escherichia coli are ubiquitous gram-negative bacteria in the intestines of warm-blooded vertebrates. *E. coli* can be subtyped by identifying the bacterial antigens “O” (cell wall) and “H” (flagellar). Most *E. coli* serotypes are non-pathogenic, but those that cause human disease are sometimes grouped by pathogenic mechanisms: enterohemorrhagic (EHEC, also called Shiga toxin-producing [STEC]), enteropathogenic (EPEC), enteroinvasive (EIEC), enterotoxigenic (ETEC), and enteroadherent (EAEC). Only EHEC is notifiable in Washington, where the most common EHEC is *E. coli* O157:H7.

Non-motile *E. coli* O157 (O157:NM, aka O157:H-) or non-O157 EHEC (e.g., O126, O111) are less common causes of enterohemorrhagic infection. The information in these guidelines is primarily based on studies of O157:H7 infections and outbreaks. It is possible that the epidemiology of other EHEC, less commonly identified in the United States, is quite different from O157:H7. Note also that the clinical manifestations and epidemiology of the non-notifiable, non-EHEC organisms, (e.g., ETEC, EPEC) is dissimilar from that of O157:H7 or other EHEC.

B. Clinical Manifestations

Mild, non-bloody diarrheal illness is common and even asymptomatic EHEC infections occur, but are rarely diagnosed outside outbreak settings. Most persons with confirmed EHEC report bloody stools, which typically begin 6–48 hours after the onset of non-bloody diarrhea. Diarrhea may be accompanied by abdominal cramps, often quite severe (and sometimes the chief complaint). Nausea and vomiting are also common. Fever is generally absent or low-grade in contrast to other bacterial enteric infections. Shiga toxin is a cytotoxin that has direct effects on intestinal cells and can cause systemic complications when present in the blood. Complications include thrombotic thrombocytopenic purpura (TTP) and hemolytic uremic syndrome (HUS.) (See *HUS guidelines for additional details*).

C. Enterohemorrhagic *E. coli* in Washington State

DOH receives approximately 130–240 reports of EHEC each year. *E. coli* O157:H7 was first identified in Washington in 1986 during outbreaks in Seattle, Spokane, and Walla Walla. Sources implicated in *E. coli* O157:H7 outbreaks in Washington have included animal exhibits, beef, lettuce, raw milk, and recreational water.

D. Reservoirs

Cattle are the best characterized reservoir species for *E. coli* O157:H7, and approximately 50–80% of cattle herds (beef and dairy) may be colonized. The organism does not cause illness in bovines. Environmental reservoirs such as water troughs and cattle feed may be important in maintaining *E. coli* O157:H7 in cattle herds. There is no effective method to eradicate *E. coli* O157:H7 from herds. Other potential sources of human infection include wild cervids (deer and elk), sheep and goats. There have been rare reports of *E. coli* O157:H7 being isolated from other species, including dogs, horses, flies and seagulls. The reservoirs for EHEC other than O157:H7 are not well characterized.

E. Sources and Modes of Transmission

Transmission is fecal-oral, most commonly through ingestion of contaminated food or direct contact with animals or their environment, including at fairs, farms or petting zoos. The infectious dose is very low. Undercooked beef (especially hamburger), other foods cross-contaminated from beef, and raw milk are the prototypical causes of common-source outbreaks, reflecting the fact that these foods are likely to be contaminated with cattle manure. Ground venison and deer jerky have also been reported as sources.

Contaminated produce, including lettuce, spinach, alfalfa sprouts, and unpasteurized apple cider, are other identified sources. Person-to-person transmission is also common, either directly (households, day care centers, institutions) or indirectly (contaminated drinking or recreational water). Infected food handlers are rarely identified.

F. Incubation Period

1–8 days; usually 2–6 days

G. Period of Communicability

Duration of pathogen excretion is typically one week or less in adults but 3 weeks in one third of children. Prolonged carriage is uncommon, but can occur.

H. Treatment

Most people recover within 5–10 days without antibiotics or other specific treatment. Supportive therapy with hydration is usually sufficient. Antibiotics should not be used to treat this infection. There is no evidence that antibiotics improve the course of disease, and it is thought that treatment with some antibiotics could lead to HUS. Children with bloody diarrhea need careful follow-up (complete blood cell count with smear, blood urea nitrogen and creatinine) to detect developing HUS. If all values are normal 3 days after the resolution of diarrhea, it is unlikely HUS will develop. Antidiarrheal agents, such as loperamide (Imodium[®]), should also be avoided.

3. CASE DEFINITION**A. Clinical Criteria for Diagnosis**

EHEC causes an infection of variable severity characterized by diarrhea (often bloody) and abdominal cramps. Illness may be complicated by HUS or TTP; asymptomatic infections occur and the organism may cause extraintestinal complications.

B. Laboratory Criteria for Diagnosis

1. Isolation of *Escherichia coli* O157:H7 from a clinical specimen, or
2. Isolation of a Shiga toxin-producing *E. coli* from a clinical specimen

C. Case Definition**1. Suspect**

Identification of Shiga toxin in a specimen from a clinically compatible case without isolation of the Shiga toxin-producing *E. coli*, or

A case of post-diarrheal HUS or TTP.

2. Probable

A case with isolation of *E. coli* O157 from a clinical specimen, pending confirmation of H7 antigen or Shiga toxin production, or

A clinically compatible case that is epidemiologically linked to a confirmed or probable case, or

Identification of an elevated antibody titer to a known Shiga toxin-producing *E. coli* serotype from a clinically compatible case.

3. Confirmed

Isolation of *Escherichia coli* O157:H7 or Shiga toxin-producing *E. coli* from a clinical specimen. CDC requests reports of O and H antigen serotypes when available.

4. DIAGNOSIS AND LABORATORY SERVICES

A. Diagnosis

EHEC is confirmed by identification of Shiga toxin-producing *Escherichia coli* in a clinical specimen. The diagnosis may be missed because detection of EHEC requires techniques not routinely performed by many laboratories; providers must inform the laboratory that EHEC is suspected. To detect *E. coli* O157, some laboratories culture stool and screen for *E. coli* O157 using sorbitol-MacConkey agar. (Most human intestinal *E. coli* strains ferment sorbitol, whereas *E. coli* O157:H7 organisms do not.) Sorbitol-negative colonies are then screened for the O157 antigen using a latex agglutination test. One disadvantage of this method is that non-O157 EHEC serotypes which ferment sorbitol can be missed.

Some laboratories use a commercial kit to identify the presence of Shiga toxin. While this detects non-O157 EHEC serotypes, laboratories that perform screening tests only cannot confirm and subtype the organism. In this case, it is particularly important to have Shiga toxin positive specimens sent to PHL for culture. In special circumstances, culture-negative patients with HUS can be tested for O157 antibodies, 2–6 weeks after onset.

B. Tests Available at Washington State Public Health Laboratories (PHL)

PHL can perform stool culture for Shiga toxin-producing *E. coli* and/or confirm the identification of an isolate as *E. coli* O157:H7. Isolates are sub-typed by pulsed-field gel electrophoresis (PFGE). Isolates with indistinguishable PFGE patterns may be consistent with, but do not prove, a common source. Isolates with dissimilar PFGE patterns are likely to be from different sources.

Non-O157 EHEC are presumptively serotyped at PHL and then sent to CDC for identification/confirmation. Serologic tests for anti-O157 antibody levels are available at CDC for special circumstances; consult CDES for more details.

Food samples from suspected outbreaks can be tested for EHEC at PHL if approved by CDES.

C. Specimen Collection

For stool culture, use a sterile applicator swab to collect stool, insert the swab into Cary-

Blair transport medium, push the cap on tightly, label the tube, and mail immediately.

Please enclose a completed PHL Enteric Bacteriology form (available at: <http://www.doh.wa.gov/EHSPHL/PHL/Forms/EntericBacteriology.pdf>) with all isolates and stool specimens.

Instructions for handling food specimens can be found in the PHL Directory of Services: http://www.doh.wa.gov/EHSPHL/PHL/Forms/directory_of_services.pdf.

5. ROUTINE CASE INVESTIGATION

A. Identify Potential Sources of Infection

Take a detailed 8-day food history. Ask about possible exposures 1–8 days before onset of symptoms (longer incubations are possible but uncommon), including:

1. Contacts or household members with a diarrheal illness. Obtain the name, phone number or address and clinical information of the ill person. Anyone meeting the suspect or probable case definition should be reported and investigated in the same manner as a confirmed case.
2. Handling or eating ground beef. Ask about consumption of undercooked hamburger (pink or red), but because of the possibility of cross-contamination any ground beef consumption is potentially an exposure. Get details about any ground beef consumed such as stores where purchased, dates of purchase, type of meat (e.g., lean or extra-lean hamburger, frozen patties), and how handled/cooked. Any raw beef is potentially a source of kitchen contamination, but intact cuts of meat sold at retail are unlikely to cause multi-household outbreaks.
3. Consumption of unpasteurized milk and unpasteurized dairy products. Identify the brands and/or sources, and find out when this consumption began. If a commercial unpasteurized product is named, notify CDES immediately.
4. Dried meats (particularly home prepared) or activities related to deer or elk hunting (slaughtering, processing, or consuming game meat.)
5. Recreational water exposure. This includes swimming, playing, or other exposure to lakes, streams, swimming pools, water parks or wading pools where water may have been swallowed.
6. Source(s) of drinking water as well as water from streams or lakes (either consumed purposefully or accidentally during work or sports activity). Water used only after boiling need not be included. If a public water supply is implicated, consult CDES.
7. Contact with livestock, especially cattle.
8. Contact with diapered children with diarrhea, or children in child care or other setting for preschool children.
9. Restaurant or other food service meals. Obtain the name and location of the restaurant and date of the meal.
10. Public gathering where food was consumed. Obtain the date, location, and sponsor of the event.
11. Occupational exposures. Evaluate the potential for exposure to human or animal excreta.

12. Travel outside Washington or the United States, or contact with others who have traveled outside the United States. Determine dates of travel.

B. Identify Contacts who Work in Sensitive Occupations

Determine if any household member or close contact attends or works at a child care facility; or works as a food handler or health care worker. If so, see Sections 6 and 7.

C. Environmental Evaluation

None, unless a commercial food service facility, child care center, or water supply appears to be implicated as the source of infection.

6. CONTROLLING FURTHER SPREAD**A. Infection Control Recommendations**

1. Hospitalized patients should be treated with standard precautions. Contact precautions should be used for diapered or incontinent persons for the duration of the illness or to control institutional outbreaks.
2. The case should be educated regarding effective hand washing, particularly after using the toilet, changing diapers, and before preparing or eating food. The importance of proper hygiene must be stressed, as excretion of the organism may persist for several weeks.
3. School Restrictions: Children should not attend school as long as they have diarrhea.
4. Work and Child Care Restrictions: Persons should not work as food handlers, child care or healthcare workers, or attend child care as long as they have diarrhea. The Washington State Retail Food Code requires food employees to report EHEC infections to their employer and requires food establishments to restrict from areas where unwrapped food or beverages are prepared and sold (if serving general populations) or exclude from the establishment (if serving highly susceptible populations) employees known to be infected with EHEC until approved to be released by the local health authority (WAC 246-215-251) (5).

In general, such workers and children with EHEC infection require two negative stool specimens before returning to work or child care. The stool specimens should be collected 24 hours apart and not sooner than 48 hours after the last dose of antibiotics, if antibiotics were given. Restrictions can be waived or modified at the discretion of the local health jurisdiction. Individuals may continue to be infectious for several weeks, however, and should be cautioned accordingly.

5. If a suspected source of infection is identified and has the potential for transmitting infection to a defined population, advise those individuals on measures to avoid exposure (e.g., boil water or drink bottled water until private well is decontaminated).

B. Case Management

Stool cultures to document that fecal shedding of the organism has stopped are not routinely indicated, except for the purpose of lifting work and child care restrictions.

C. Contact Management

1. Symptomatic contacts: All contacts with symptoms compatible with EHEC should be referred to a healthcare provider for assessment and laboratory testing. Contacts with recent or current disease are probable cases, and should be managed and reported as such on separate forms.
2. Asymptomatic contacts: Cultures should be considered if an asymptomatic household member or other close contact works as a food handler, healthcare worker, child care worker, or attends child care.
3. Education: All contacts should be educated about transmission routes, symptoms, and effective hand washing, particularly after using the toilet, changing diapers, and before preparing or eating food.

D. Environmental Measures

If indicated, give advice on proper cooking and food handling practices to prevent infection.

7. MANAGING SPECIAL SITUATIONS

A. Possible Foodborne or Waterborne Outbreaks

EHEC is a frequent cause of foodborne disease. Call CDES immediately if you suspect a common-source outbreak.

B. Case Attends or Works in a Child Care Facility

1. Interview the operator and inspect attendance records to identify other possible cases among staff or attendees during the previous month.
2. Review food handling, hand washing techniques, and diaper changing practices with the operator and staff.
3. Collect stool specimens from any other attendees or staff with a history of a diarrheal illness consistent with EHEC in the recent past.
4. Exclude cases (including those who are asymptomatic) from child care facilities until they have two negative stool cultures collected at least 24 hours apart and at least 48 hours after discontinuation of antibiotics if antibiotics were taken (antibiotics are not recommended).
5. If more than one case or suspected case is identified among attendees or workers at a child care facility, inspect the facility.
6. Instruct the facility operator to call the LHJ immediately if new cases of diarrhea occur.
7. Make follow-up contact with the child care center to assure that surveillance and appropriate prevention measures are being carried out. Manage newly symptomatic children as outlined above.

C. Cases Linked to Raw Milk Products

Environmental evaluation of the dairy will be a necessary part of any further investigation. Dairy investigations will be conducted in cooperation with the Washington State Department of Agriculture.

D. Case Resides at a Health Care or Residential Care Facility

Determine if there has been any unusual incidence of diarrheal illness within the past month. If so, investigate these reports to identify possible common-source outbreaks or any continuing sources of exposure. If indicated, conduct a sanitary inspection of the facility. The extent of further investigation depends on circumstances.

8. ROUTINE PREVENTION**A. Vaccine Recommendations:** None**B. Prevention Recommendations for EHEC and Other Enteric Illnesses**

Advise individuals on measures to avoid further or future exposures including:

1. Avoid eating raw or undercooked meat, especially hamburger. Hamburger prepared at home should be cooked to an internal temperature of at least 160° F. While it is best to use a thermometer, cook at least until there is no red or pink remaining and meat juices have no color.
2. Avoid cross-contamination with meat or other potentially contaminated foods.
3. Wash fruits and vegetables thoroughly before consumption. Peel when possible.
4. Wash hands after caring for diapered children or incontinent persons, after using the toilet, and after handling soiled clothing or linens.
5. Wash hands after handling pets, fowl, other animals, raw meat, and raw poultry, and always before food preparation.
6. Avoid unpasteurized milk, and other unpasteurized products including soft cheese, juices, and cider.
7. Avoid drinking or swallowing untreated surface water. Untreated water should be boiled or otherwise disinfected before consumption.
8. Persons with EHEC should not use recreational water venues (e.g., pools, lakes, interactive fountains, water parks) until 2 weeks after symptoms resolve.

ACKNOWLEDGEMENTS

This document is a revision of the Washington State Guidelines for Notifiable Condition Reporting and Surveillance published in 2002 which were originally based on the Control of Communicable Diseases Manual (CCDM), 17th Edition; James Chin, Ed. APHA 2000. We would like to acknowledge the Oregon Department of Human Services for developing the format and select content of this document.

UPDATES

10/9/07 Section 8B(8): Persons with EHEC should not use recreational water venues until 2 weeks after symptoms resolve.